EFFECTS OF A NUCLEAR DETONATION

Subject: Science | **Current:** 2010 | **Grade:** 9-12 **Day:** 3 of 4

1 Purpose

To have the student learn the physical effects that a detonation of a nuclear weapon.
has on both structures and living organisms.

2 Duration

50 min.

3 Objectives

Students should be able to:

- List the types of effects from a nuclear detonation, and the relative distribution of these effects.
- Explain the concept of overpressure from a shock front.
- Explain the differences between acute and chronic health impacts from nuclear detonations.
- Differentiate between prompt radiation and induced, or delayed radiation (i.e., fallout).
- List and explain the factors affecting radiation damage to humans.
- Explain the concept of 'nuclear winter'.

4 Standards Addressed

BIOLOGY

Explain that gene mutations in a cell can result in uncontrolled cell division, called cancer. Also know that exposure of cells to certain chemicals and radiation increases mutations and thus increases the chance of cancer. **B.1.25**

CHEMISTRY-PHYSICS

Know and explain that the nucleus of a radioactive isotope is unstable and may spontaneously decay, emitting particles and/or electromagnetic radiation. **CP.1.8**

Know and explain that transformations of energy usually transform some energy into the form of heat, which dissipates by radiation or conduction into cooler surroundings. **CP.1.17**

PHYSICS

Identify electromagnetic radiation as a wave phenomenon after observing refraction, reflection, and polarization of such radiation. (Core Standard) **P.1.26**

Indiana Department of Education. (n.d.). Indiana Standards and Resources: Sciences: Physics, Biology, and Integrated Chemistry and Physics. Retrieved from http://dc.doe.in.gov/Standards/AcademicStandards/StandardSearch.aspx

5 Vocabulary

Nuclear Terrorism & Nuclear Weapons - Effects of a Nuclear Detonation

- **Acute**: Health effect resulting from a massive dose of an environmental insult over a short period.
- **Chronic**: Health effect resulting from small doses of an environmental insult over long periods.
- **Fallout**: Residual radioactive material following a nuclear detonation. Radioactive particulates are first released into the atmosphere, following which they will rain down on Earth. This process may take from minutes to decades.
- **Latency period**: Time interval between dose and detection of symptoms.
- **Overpressure**: The increase in atmospheric pressure over normal air pressure. It is the overpressure which kills via damaging essential organs; overpressure will also destroy structures.
- **REM (Roentgen Equivalent Man)**: A measure of radiation dose received by an individual. Although data varies, a single exposure in the tens of REMs is considered dangerous to health.
- **Yield**: The amount of energy released from a nuclear detonation, measured in units of tons of TNT.

6 Materials

Lecture 3, Supplementary Material File

7 Procedures

Lecture followed by examination.

A. Introduction

Nuclear weapons are the most powerful of all WMDs. The detonation of a nuclear device by a terrorist group would result in catastrophic physical effects including blast overpressure, thermal effects and radiation contamination, and also cause tremendous psychological impacts worldwide.

It is essential for the emergency responder to be aware of the effects of nuclear hazards so that communities can be best prepared in the event of an emergency.

B. Development

On the first day the instructor will go over the introduction and the background of nuclear hazards, specifically nuclear radiation. On the second day will be a survey of the various types of nuclear weapons. The third day will encompass a discussion of the effects of nuclear weapons. On the fourth day the students will use a computer model to predict possible blast and fallout effects from a major nuclear detonation in the United States.

During Days 1-3 the class will take notes. They will also discuss how a nuclear incident would impact their community and the larger region (e.g., state, Midwest U.S.), should an attack ever occur there.

C. Practice

On the third day the material on nuclear weapons and radiation from the previous two days will be reviewed. The instructor will give a lecture about the effects of nuclear weapons and the students will add it to their previous day's notes. The class will then brainstorm recommendations for preventing a nuclear attack by a terrorist organization. The teacher will add to this list recommendations that the students may not have included, which are in the lecture notes.

D. Independent Practice

On the fourth day the students will complete the computer model activity.

E. Accommodations (Differentiated Instruction)

Students who have visual, mobile or hearing impairments may need adaptive computer software to assist with using the computer and accessing the websites for information during the simulation.

Students who are ELL as well as other students who may have developmental issues may need more scaffolding during the simulation to be able to complete it. This could be in the form of additional prompts for each question and a graphic organizer, perhaps a flow chart, to assist them in staying on track and managing the information.

For highly able/gifted students, you may want to make the simulation more abstract, by giving them less structured questions. You may just provide them with the scenario; let them figure out what needs to happen next, where to go for information, and so forth. Check in with them, ask some probing questions, and then give them the updates to the scenario.

F. Checking for Understanding

The teacher will ask questions throughout the presentation to check for understanding and have the students answer them. The answer will be provided right away.

G. Closure

Carerrs in this area include:

- Directorate for Science and Technology: http://www.dhs.gov/xabout/structure/editorial_0530.shtm
- Domestic Nuclear Detection Office: http://www.dhs.gov/xabout/structure/editorial_0766.shtm
- Federal Bureau of Investigation: www.fbi.gov
- Federal Emergency Management Agency: www.fema.gov
- U.S. Department of Homeland Security: www.dhs.gov
- U.S. Coast Guard: http://uscg.mil
- U.S. Immigration and Customs Enforcement: www.ice.gov

8 Evaluation

At the end of the unit, the students will be given a written exam that covers all of the topics covered.

9 Teacher Reflection

The teacher will reflect on the lesson after teaching it.

10 Media & Resources

Lecture 3, Supplementary Material File

- Directorate for Science and Technology: http://www.dhs.gov/xabout/structure/editorial_0530.shtm
- Domestic Nuclear Detection Office: http://www.dhs.gov/xabout/structure/editorial_0766.shtm
- Federal Bureau of Investigation: www.fbi.gov
- Federal Emergency Management Agency: www.fema.gov
- U.S. Department of Homeland Security: www.dhs.gov
- U.S. Coast Guard: http://uscg.mil
- U.S. Immigration and Customs Enforcement: www.ice.gov